(THE CONVECTIVE HEAT TRANSFER BIBLIOGRAPHY)

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Science and Technology Division
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THE CONVECTIVE HEAT TRANSFER BIBLIOGRAPHY

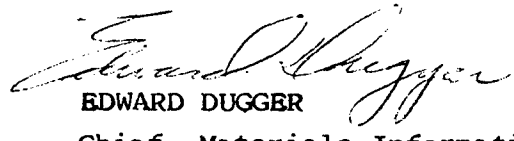
CLEMENT R. BROWN

FOREWORD

This report has been prepared by the Science and Technology Division, Library of Congress, as a task under Delivery Order No. D. O. 33(657)-63-388 and previous Orders, which covered the compilation of a bibliography and index on the subject of convective heat transfer. The work has been carried out under the direction of the Materials Information Branch, Materials Applications Division, Air Force Materials Laboratory, with John H. Charlesworth, MAAM, as project monitor. This is a summary technical report covering the entire task from February 1961 through August 1967.

The compilation of the Convective Heat Transfer Bibliography was performed under the direction of Dr. Clement R. Brown, Head of the Special Bibliographies Section, with the assistance of quite a few people, most of whom are no longer at the Library of Congress. The major professional contributions were made by Joseph Enke, Jack R. Gibson, Thomas Goodwin, Peter Halpin, Thomas LaMoure, and Miss Joyce Wolfe. Clerical assistance was rendered by Mrs. Lillie Frye, Mrs. Virginia Sims, and Mrs. Beatrice Treese, and particularly Mrs. Patricia Gravatt, who typed most of the abstract cards. Our special thanks go to Mrs. Treese, Mrs. Frye and Mr. Gibson for their excellent work in coding the 2000 abstract cards for subject indexing and preparing the code listings. Finally, we are indebted to Mr. John Charlesworth of AFML for his guidance on this task and his patience in awaiting the final products.

This report has been reviewed and is approved.



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ABSTRACT

The Convective Heat Transfer Bibliography is a compilation of 2000 references with abstracts to the monographic, periodical, and report literature issued from 1955 to 1962, on the subject of convective heat transfer and its aerospace applications. The references and abstracts have been typed on 5x8 cards. The bibliography is supplemented by a set of 2000 IBM punched cards, constituting a subject index in considerable depth to the same references, and suitable for retrieving the information in the respective abstracts. This report defines the scope of the task, outlines the bibliographic procedures followed, and describes the end products resulting from the work.

TABLE OF CONTENTS

THE CONVECTIVE HEAT TRANSFER BIBLIOGRAPHY

I. INTRODUCTION

The Convective Heat Transfer Bibliography is a compilation of 2000 references with abstracts of monographic, periodical, and report literature issued from 1955 to 1962 on the subject of convective heat transfer. It is supplemented by a set of 2000 IBM punched cards constituting a subject index in considerable depth to the same references. It was compiled by the Special Bibliographies Section of the Science and Technology Division, Library of Congress, for the Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio, under Delivery Order (33-616)-61-05, and subsequent Delivery Orders. The IBM punched cards are intended to serve as a "satellite" subsystem to the extensive Document Retrieval System now in operation at the Aerospace Materials Information Center of AFML.

This report describes the task as originally defined and its later modifications, the scope of the literature search carried out, the characteristics of the individual reference and abstract, card, the bibliographic procedures followed, and finally the IBM cards and codes forming the subject index suitable for retrieving the information in the respective abstracts.

II. THE TASK

1. Requirements. As defined in the original Delivery Order (33-616)-61-05, this task was the compilation and indexing of a comprehensive bibliography on convective heat transfer, with abstracts. Each reference was to be typed on a 5x8 card, furnished in duplicate, serially numbered, and assigned "descriptive terms" indicating the subject matter of the reference. In addition, each of these index terms was to be key-punched on a standard 80 column IBM card, with the serial number and other identification for the given reference.

2. Previous history. Interest in the compilation of the present bibliography was engendered by the existence, in the files of the Science and Technology Division of the Library of Congress, of an incomplete compilation of several thousand unannotated references on the very broad subject of Heat Transfer. This compilation had been started under a general Office of Naval Research contract (primarily covering other services) but which was discontinued by ONR, along with other literature surveys, for budget

reasons. It was therefore originally intended to include all of those references (1938-1949) related to the subject of convective heat transfer in the present compilation, but this has not been possible as will be explained later.

3. Administrative changes. The terms, including the scope of the compilation, of Delivery Order (33-616)-61-05 were based upon an estimate of costs and time required, submitted previously by the Library of Congress. A sampling type of preliminary survey of existing literature had at that time indicated that the task would require at least three years, and a tentative annual rate of funding was suggested. This rate of funding was followed for the first two years, but before the end of two years work, it was evident that at least two more years work would be required, with an appreciable increase in funding, if LC was to cope with some 100% increase in heat transfer literature between 1958 and 1961, undoubtedly resulting from the developing interest in space travel and high-speed aircraft at that time. At the request of AFML, a revised budget was submitted in January 1963, but after several months delay, we were advised that the Air Force would be unable to furnish more than 70% of the funds requested, with no assurance of further funds in the future. This decision greatly affected the further progress of the task and was the primary reason why the task was not completed as originally planned. The resulting changes in plans and the final product will be indicated later.

III. SCOPE

1. Subject. The subject scope was well-defined in the above Delivery Order by means of an outline agreed upon by the Air Force Materials Laboratory (AFML) and the Library of Congress (LC). Both free and forced convective heat transfer, the effects of various factors, heat transfer processes involving convection, heat transfer media, heat exchangers, and heat transfer and related measurements, were to be included. Later, a "Guidance Outline," indicating in more detail which subjects were to be included, and which were to be excluded, was drawn up in a conference between representatives of AFML and LC. With few modifications, the Subject Outline and Guidance Outline have been followed carefully in searching for references throughout the task. Both are shown in Appendix I.

2. Time period to be covered. Originally it was intended to include the applicable references to literature issued from 1938 to 1949, compiled previously, and all literature published from 1950 on.

When the funds became curtailed in 1963, however, it was decided to cover as much of the literature after 1954 as possible, and hopefully to include the earlier compilation.

3. Types of literature. Monographs (books) and journal papers, in English, French, German, Russian and other languages, were to be included, together with both unclassified and classified reports. Actually, however, the bulk of the material is in English, and with few exceptions, only unclassified reports have been included. The titles and abstracts for the latter are unclassified.

IV. THE REFERENCE AND CARD

Each item in the bibliography consists of a citation, or reference, and an abstract, on a 5x8 card, with assigned index terms.

1. Citation. For books, the citation gives in this order:

Name of the first author, followed by his initials.

Names of other authors, if any, in normal order.

Title in English, in brackets if translated.

Title in original language, if other than English.

Place of publication.

Date of publication.

Number of pages.

The citation for journal articles gives:

Name of first author, and initials.

Names of other authors, if any, in normal order.

Title in English, in brackets if translated.

Title in original language, if other than English.

Name of journal, using abbreviated elements (See Appendix II).

Journal volume number, issue number, date, and full pagination of paper.

The citation for reports is similar to that being used in the Technical Abstract Bulletin, and is as follows:

Name of corporate author (Agency or contractor), giving the parent organization first, followed by the name and location of the major subdivision doing the work.

Title of the report.

Names of personal authors.

Date of report, pagination, notes on tables etc.

Contract number, if any.

Contractor's (or sponsoring agency's) report number.

Accession number in a collection (e.g., AD 191234).

Security classification.

Further identification, such as translation information, paper number in a series, etc. is frequently added.

2. Abstract. The abstract is usually of the informative type, describing the work that was done, and summarizing the principal results obtained. The author's (or contractor's) abstract has been used whenever it has been deemed adequate for the purpose of the bibliography, in which case credit is given.

3. Abstract card. Each reference and abstract has been typed on a 5x8 card, identified by a six-digit number in the upper right corner. The first two digits indicate the year of publication and the last four an "accession number" for publications of that year, assigned as the item was being processed. Open literature items (books and journal articles) were assigned numbers below 5000, while reports have numbers from 5000 up. (Some numbers were assigned to items later omitted so that for any one year some consecutive numbers may be missing.) The various subject index terms assigned to the given

reference are listed at the bottom of the card, below the abstract. In the case of lengthy abstracts, a continuation card (or cards) was used, and the index terms appear on this card.

4. Subject index terms. Every item has been assigned a number of index terms which serve to indicate all of the subjects relating to convective heat transfer and of significant importance in the given item. These subject index terms were selected from a list of about 1000 terms which had been compiled by the bibliographers and approved by the Air Force Materials Laboratory after revision. The "Alphabetical Listing of Subject Codes" (See Appendix IV) constitutes a complete list of the subject terms used, although it should be noted that in some cases the original term used on the card has been edited or elaborated in compiling the Alphabetical Listing.

V. PROCEDURE

In compiling this bibliography some seven operations were involved. These included: searching, verifying, abstracting, indexing, editing, typing, and proofreading.

1. Searching. The first step consisted of compiling as many references as possible which were tentatively judged to be pertinent to the subject on the basis of title, abstract or subject indexes, etc. The following are the principal sources which have been searched for this task:

Library of Congress card catalogs.

Engineering Index, 1949-1961.

Heat Bibliography (annual volumes issued by the Department of Scientific and Industrial Research, Great Britain)

About 50 "core" journals, cover to cover.

Various symposia, etc., on heat transfer.

Title Announcement Bulletin (original TAB), complete from 1953 to 1957.

Technical Abstract Bulletin (present TAB) from 1957 through 1961.

Various bibliographies appearing in publications already abstracted.

Many other sources, such as Chemical Abstracts and Science Abstracts, could have been searched if more time and funds had been available. As it was, a total of over 18,000 unverified references were obtained by searching. Assuming that many of these would eventually be eliminated as duplicates or not pertinent, it is obvious that had it been possible to follow the original plan, a bibliography of several thousand more items could have been compiled. In addition, there could have been some 1500 unannotated references to the 1938-1949 publications collected in the previous task, but not edited.

2. Verifying and abstracting. Every effort is made to verify references in the original, which serves to eliminate errors in the citation, to determine that the publication is pertinent to the subject, to permit the preparation of an adequate abstract, and to provide additional references to the subject. If the paper is pertinent, abstracting is done at this time, or the author's abstract is used, if adequate (See Sect. IV-2 for a description of the abstract). A total of 2800 abstracts were prepared, but it was possible to index, edit, and type only 2000 of them in the final form.

3. Indexing. In general, the assignment of the subject index terms (See Section IV-3) was made later inasmuch as it was not advisable to establish the list of index terms until at least 1000 references had been abstracted. Usually indexing was done by the editor, and has been based on the abstract rather than the complete paper.

4. Editing. Experienced personnel, thoroughly familiar with the subject, were assigned to editing both the citation and abstract, and selecting the index terms. The editing bibliographer was responsible for determining that the abstract and indexing were adequate.

5. Typing and proofreading. After editing the complete reference, abstract and index terms were typed on a 5x8 card, using an IBM proportional spacing electric typewriter, in "Charter" type. If necessary, a second and third card was used rather than type on the back of the first card. The card was then proofread, and after corrections had been made, three Xerox copies were made. Two of these were sent to AFML in sets of 1000 references each. Samples of completed cards are shown in Appendix III.

VI THE IBM CARD

The final phase of this task was the preparation of a master set of IBM cards with the following information:

Abstract card number
Author (or authors)
Index terms in code

1. Abstract card number. The abstract card number consists of the six digit number assigned to the reference at time of processing (See Sect. IV-3), which serves to indicate the year of publication, whether the item is a report or an "open" publication, and the accession number, prefixed by the letter C to indicate a Library of Congress abstract. This is followed by 1, 2, or 3 which indicate this is the first, second or third IBM card for this item. The first 10 columns on the IBM card are used for this identification. Examples are:

C58-0116-1
C60-5008-2

2. Author(s). Columns 12 through 32 are used for authors. For books and papers, the last name of the first author followed by his initials (without periods), and as much of the names of second and third authors, without initials but separated by spaces, as 21 columns would permit, are punched directly on the card. Thus the authors of Item no. 58-0116 are P. Fortescue and D. V. Wordsworth, which names become FORTESCUE P WORDSWORT on the card. Anonymous publications are indicated by the first 21 letters of the title; thus the entry for "New Metals-Research and Production" becomes NEW METALS RESEARCH. Punctuation and diacritical marks are omitted.

For reports, the first 21 letters of the name of the organization producing the report are used. Thus Sylvania Electric Products, Inc., etc., becomes SYLVANIA ELECTRIC PRO. In general, commonly accepted abbreviations have been used, including acronyms such as NASA for National Aeronautics and Space Administration, WADC for Wright Air Development Center, etc.

3. Index terms in code. Each index term has been assigned a three digit (in a few cases four digit) code number and the IBM cards have been punched with the code numbers corresponding to the subjects listed on the abstract cards. For example, abstract number 58-0116 has been indexed and coded as follows:

Gas turbines	325
Regenerators	672
Heat exchangers	354
Coolants	158

These numbers appear along the top right margin of IBM card no. C58-0116-1. Columns 34 to 80 inclusive have been reserved for the subject codes, which permits a maximum of twelve three-digit codes, separated by spaces. A second IBM card, identified in the same manner as the first, except with the number 2 in column 10, has been used wherever there are more than twelve subjects and a third card for more than 24 index terms.

Since there turned out to be a total of 1031 index terms, it was necessary to assign 4-digit codes to 32 subjects. On the 24 IBM cards affected, the four-digit codes are punched first, without spaces, followed by the three-digit numbers spaced as usual. This Card number C60-0218-1 is coded 101610141030 352 488, indicating five subjects.

4. Subject code listings. Two code listings for use with the IBM master cards have been supplied. The Numerical Listing in an arrangement of all subject codes used, from 001 to 999, and from 1001 to 1032, in numerical order. The Alphabetical Listing is a list of the same subjects, in alphabetical order, with the corresponding code number in the left column. Certain characteristics of the terminology and word order used in these listings are pointed out, and a special table listing the temperature ranges corresponding to codes 795 to 805 inclusive, is included.

The following are illustrated in Appendix IV:

(1) Sample IBM card for an open literature item showing personal author (C58-0116-1)

(2) Sample IBM cards for a report item, showing corporate author and more than 12 subjects requiring two cards (C60-5008-1 and C60-5008-2)

(3) Sample IBM card, using four-digit subject codes (C60-0218-1)

(4) Subject code; numerical listing.

(5) Subject code; alphabetical listing.

(6) Codes for temperature ranges.

VII. SUMMARY AND CONCLUSIONS

A partial bibliography on Convective Heat Transfer, consisting of 2000 references with abstracts, to both published literature and reports issued during the period 1955 - 1962 has been compiled for the Air Force Materials Laboratory. Each reference has been subject-indexed in considerable depth, using about 1000 approved terms, based primarily on the material at hand. The reference, abstract and index terms have been typed on 5x8 abstract cards, two copies of which were delivered to the Air Force Materials Laboratory in lots of 1000 each. In addition the sponsoring agency has been supplied with a master set of over 2000 IBM cards, each identified by a number and the name of either the personal or corporate author, and punched by a series of numeric codes indicating the index terms assigned to the given reference.

APPENDIX I

a. Subject Outline

1. Heat transfer in general

2. Convection

   (a) Theory
   (b) Mathematics
   (c) Natural convection
   (d) Fluid flow with heat transfer

3. Effects of various factors

   (a) Gravity
   (b) Centripetal acceleration
   (c) Pressure
   (d) Electromagnetic forces
   (e) Boundary conditions
   (f) Turbulence
   (g) Magnetic and electric fields

4. Heat transfer processes involving convection

   (a) Boiling
   (b) Evaporation
   (c) Condensation
   (d) Thermal diffusion

5. Heat transfer media

   (a) Liquid metals
   (b) Organic fluids
   (c) Other fluids
   (d) Two phase mixture

6. Heat exchangers in general

   (a) Theory
   (b) Design
   (c) Operation
   (d) Performance

7. Heat exchanger types

   (a) Boilers
   (b) Condensers
   (c) Fluid heaters
   (d) Evaporators
   (e) Cooling equipment

8. Heat transfer and related measurements

   (a) Conductivities
   (b) Emissivities
   (c) Heat transfer coefficients
   (d) Temperature
   (e) Pressure
   (f) Viscosity
   (g) Heat content
   (h) Specific heat

b. Guidance Outline

Object: Convective heat transfer with respect to fluid heat transfer media, including those which can be used as coolants and lubricants for aircraft and space vehicle power systems; also environmental heat transfer within and without the aircraft or space vehicle, including aerodynamic heating. Research, development and applications to be included.

To be included	To be omitted
I. HEAT TRANSFER IN GENERAL	
Convection	
Cryogenics down to temperature of liquid oxygen (-218°C)	Conduction per se Radiation per se Convection only below -218°C 1°K (Absolute zero)

To be included	To be omitted

I. HEAT TRANSFER IN GENERAL (continued)

Related fields

In any case: Magnetohydrodynamics (possibly)	Unless convective heat transfer is involved: Fluid dynamics Reacting gas Dissociating gas Turbulence Boundary layer Mass transfer Thermodynamics Heat insulation

II. CONVECTION

Theory
Mathematics
Natural convection
Forced convection
Fluid flow with H.T.
to or from the fluid

Heat sources

Aerodynamic heating	Electrical induction Radioactivity Acoustical energy

Convection in:

Ceramics	Air conditioning
Chemical engineering	Biology
Electrical equipment cooling	Chemistry in general
Electronic equipment cooling	Household heating
Metallurgy	Industrial heating
Nuclear physics	Medicine
Physical chemistry	Meteorology
Physics	Oceanography
Refrigeration	
Solar power	
Waste heat utilization	

To be included	To be omitted

II. CONVECTION (continued)

Specific subjects

	Flow with shock wave
	Entropy changes
	Thermodynamics
	Energy balances
	Compression without heat addition externally

III. EFFECTS OF VARIOUS FACTORS

Boundary conditions	Acoustics
Centripetal acceleration	Chemical reactions
Density	Combustion
Dissociation-association	Shock waves
Electromagnetic forces	
Gravity	
Ionization	
Pressure	
Turbulence	

IV. HEAT TRANSFER PROCESSES INVOLVING CONVECTION

Boiling	Ablation
Condensation	Natural evaporation
Evaporation	
Fusion	
Melting	
Solidification	
Sublimation	
Supercooling	
Thermal diffusion	
Transpiration	
Physical chemistry aspects of changes in state	

To be included	To be omitted

V. HEAT TRANSFER MEDIA

Coolants	Antifreeze as such
Liquid metals	Non-Newtonian fluids
Lubricants	Plasmas (outer space)
Organic fluids	Solids in "fluid-like" form
Steam (limited*)	
Two phase mixtures	
Water (limited*)	

*omit basic thermal properties (steam tables, etc.)

Properties

Emissivity	Other thermodynamic properties (entropy, etc.)
Flammability	Quality of steam
PVT relations	
Specific heat	
Specific volume	
Thermal conductivity	
Thermal diffusivity	
Toxicity	

VI. HEAT EXCHANGERS IN GENERAL

Theory	Methods of testing
Design	Manufacture
Operation	Maintenance
Performance	Repair
Components	Automatic control systems
Tubes	
Fins	
Plates	

1955 forward only:
- Control devices:
  - Temperature
  - Pressure
  - Flow

To be included	To be omitted

VI. HEAT EXCHANGERS IN GENERAL (continued)

Design, operation and performance factors

Resistance to fluid flow
Effects of corrosion, scale, etc. on H.T.

1955 forward only:

Handbook data
Strength
Thermal efficiency
Thermal economy
Mechanical efficiency
Cost economy

VII. HEAT EXCHANGER TYPES

Boilers	Distillation equipment
Condensers	Economizers
Cooling equipment	Furnaces
Evaporators	Heat pumps
Fluid heaters	Heaters
Regenerators (non-steam)	Preheaters
Superheaters (non-steam)	Steam regenerators
	Steam superheaters

a. Types of boilers

Water tube	Stationary (power plants)
Fire tube	Marine
Electric	Package
Nuclear	

b. Types of cooling equipment

Water as coolant	Spray cooling
Air as coolant	
Vapor phase cooling	
Evaporative cooling	
Transpiration cooling	

To be included	To be omitted

VII. HEAT EXCHANGER TYPES (continued)

For power equipment only:

Oil coolers
Intercoolers
Intake charge cooling

c. Cooling applications

Aircraft engines	Automotive engines
Gas turbines	Diesel engines
Rocket motors	Machining operations

For aircraft or space vehicles only:

Space cooling
Mechanical equipment
Electrical equipment
Electronic equipment

d. Types of fluid heaters

Gases	Feedwater
Organic liquids	
Other H.T. media	

e. Kinds of reference material

News items with something revolutionary only	Popular material
Descriptive material if quantitative data are given	News items in general
Reviews with H.T. data	Short descriptive material
Critical evaluations, comparisons, etc. of methods, equipment, instruments	Descriptive material without design or performance data

To be included	To be omitted

VIII. HEAT TRANSFER AND RELATED MEASUREMENTS

Thermal conductivity
Emissivity
Heat transfer coefficient
Temperature
Pressure
Density
Viscosity
Fluid flow
Heat content
Specific heat

a. Measurements in general

Effects of factors listed in III
* Errors and corrections in measurement
Instruments:
  *Design principles and data
  *Accessory equipment such as leads, circuits, indicators, recorders
  *Applications
  *Proper installation
  *Operation
  *Calibrating methods

Theory
Mathematics
Interpretation aids:
  Charts
  Nomographs
  Formulas
  Correction tables, etc.
Industrial equipment in general

b. Thermal conductivity

Data

Fluids
Heat exchanger materials

Mathematical derivations

Fluids

Solids

* For precision type laboratory and research instruments only

*Omit for industrial type of instruments

To be included	To be omitted

VIII. HEAT TRANSFER AND RELATED MEASUREMENTS (continued)

Methods of determination

Fluids	Solids

c. Emissivity

Data for fluids and solids	Total radiation Method of measurement

d. Heat transfer coefficient

Data for all conditions involving fluids Data for all types of heat exchangers in VII Methods of measurement or calculation Derivation of formulas	Data for solids Heat exchangers omitted in VII Structural elements

e. Temperature

Range:
Liquid O_2 to over 100,000°F
Differential temperature measurements
Calibration methods down to -80°F

Instruments

*Thermometers *Thermocouples *Thermopiles *Pyrometers *Resistance thermometers	Temperature indicating paints and crayons Spectroscopic methods in general

f. Pressure

Range: 10 mm. absolute to 3000 p.s.i. Differential pressure measurements	Pressure due to light, sound, etc.

To be included	To be omitted

VIII. HEAT TRANSFER AND RELATED MEASUREMENTS (continued)

Instruments

*Vacuum gages
*Manometers
*Pressure gages

g. Density (Specific volume)

Data for fluids	Data for solids
Temp. range as in (e)	Method of determination
Pressure range as in (f)	

h. Viscosity

Data for Newtonian fluids	Non-Newtonian fluids
Methods of determination	
Theory	
Formulas	

i. Fluid flow

Range:
No restrictions
Calibration methods

Instruments

*Flowmeters	Pitot tubes
*Rotameters	Displacement meters
*Orifice meters	
*Electromagnetic flowmeters	

Applications

*Air
*Gases
*Water
*Oil
*Organic liquids

*Precision type laboratory and research instruments only	*Omit industrial type instruments

To be included	To be omitted
VIII. HEAT TRANSFER AND RELATED MEASUREMENTS (continued)	
j. Heat Content	
Data on fluids	Data on solids Methods of determination
k. Specific heat	
Data	
Fluids and solids Both C_p and C_v	
Methods of determination	
Fluids	Solids

APPENDIX II

List of Abbreviated Words for Serial Titles

acad.	Academy
aeronaut.	Aeronautic(al), Aeronautics
akad.	akademiîa [Ru]
Amer.	American
appl.	Applied
Brit.	British
bur.	Bureau
canad.	Canadian
chem.	Chemical, Chemistry
conf.	Conference
eng.	Engineering
engrs.	Engineers
indus.	Industrial, Industry
inst.	Institute, Institution
internat.	International
izvest.	izvestiîa [Ru]
jour.	Journal
mag.	Magazine
math.	Mathematical, Mathematics
mech.	Mechanic(al), Mechanics
nat.	National

List of Abbreviated Words for Serial Titles (continued)

philos.	Philosophic(al)
phys.	Physical, Physics
proc.	Proceedings
progr.	Progress
quart.	Quarterly
refrig.	Refrigeration
res.	Research
rev.	Review
roy.	Royal
sci.	Science
scient.	Scientific
soc.	Society
technol.	Technologic(al), Technology
trans.	Transactions
univ.	University
zeitschr.	Zeitschrift [Ge]

APPENDIX III

Sample Reference-Abstract Cards

55-0001

Fuks, N. A.

[THE MECHANICS OF AEROSOLS.] Mekhanika aerozolei. Moskva, Izdatel'stvo Akademii Nauk SSSR, 1955, 351 p. (Translated as CWL Special Publication 4-12, Army Chemical Center, Chemical Warfare Labs., Md., [1958], 448 p. 581 refs. QD549.F913; AD 227876) QD549.F9

Limited information is contained on interrelations of aerosols and such thermal phenomena as convection, diffusion, evaporation, condensation, and action of radiometric forces (aerosol particles being repelled by heated bodies.)

58-0116

Fortescue, P. and D. V. Wordsworth

GAS-TURBINE REGENERATOR PERFORMANCE. Eng., v. 185, Feb. 25, 1958: 284-286.

This article seeks to show how the bulk of a regenerator, in a very-high-temperature nuclear reactor-gas turbine closed circuit, is affected by the choice of working fluid. Completely general conclusions about heat-exchanger sizes are reached and quantitative results with different gases are tabulated.

60-5008

National Bureau of Standards. Cryogenic Engineering Lab., Boulder, Colo.

A COMPENDIUM OF THE PROPERTIES OF MATERIALS AT LOW TEMPERATURE (PHASE I). PROPERTIES OF FLUIDS, V. J. Johnson - ed. Rept. for Jan. 1958 - Mar. 1959 on Thermophysical Properties of Cryogenic Materials. Oct. 1960, 1 vol., diagrs., tables, refs. (AF 33(616)58-4; WADD TR 60-56, pt. 1) AD 249644 UNCLASSIFIED

Data are given for the properties of density (including some PVT data), expansivity, thermal conductivity, specific heats and enthalpy, transition heats, phase equilibria, dielectric constants, adsorption, surface tension and viscosity for the solid, liquid and gas phases of helium, hydrogen, neon, nitrogen, oxygen, air, carbon monoxide, fluorine, argon and methane wherever adequate data could be collected. Data sheets, primarily in graphic form, are presented from "best values" of data collected. The source of the material used, other references and tables of selected values with appropriate comments are furnished with each data sheet to document the data presented. Conversion tables and other helpful information are also included. Although bound, the volume is intended basically as a looseleaf report for continuous expansion and revision as new and revised data sheets are produced. The specified temperature range of primary interest was from near absolute zero to 110°K. Where desirable and practicable, however, data are included for temperatures up to near room temperature (300°K). (Author, modified)

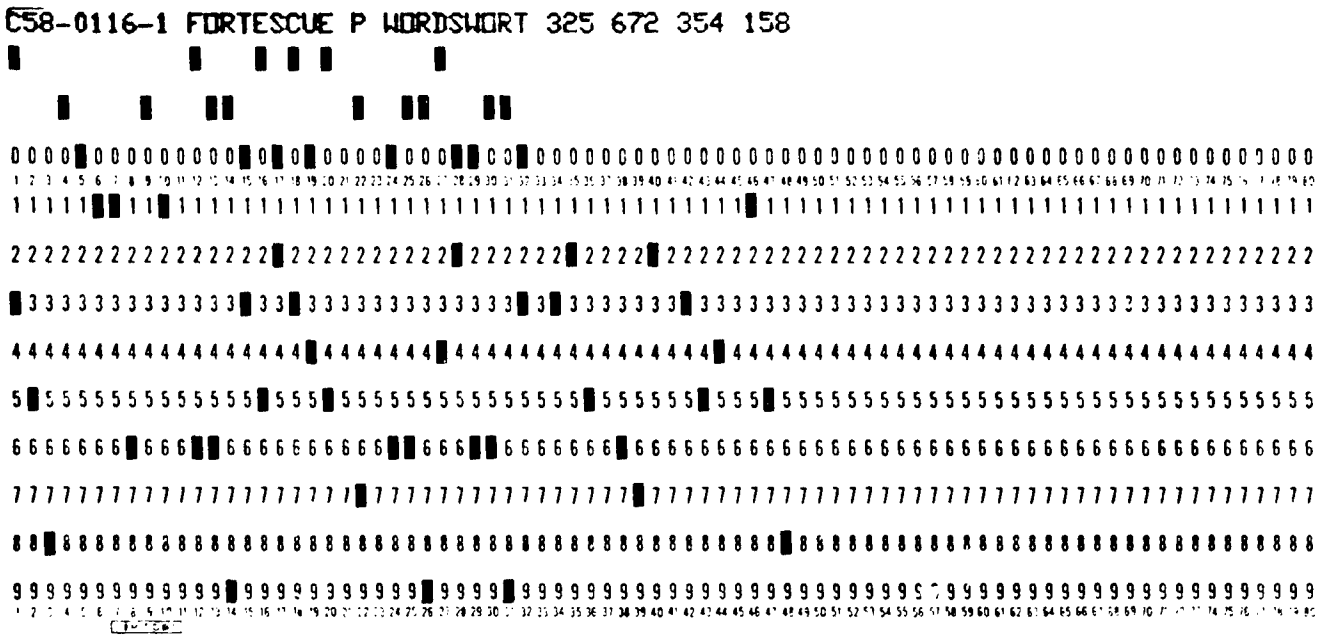
Cryogenic fluids; Liquids; Gases; Temperature, cryogenic; Helium; Hydrogen; Neon; Nitrogen; Oxygen; Air; Carbon monoxide; Fluorine; Argon; Methane; Density; PVT data; Thermal conductivity; Specific heat; Enthalpy; Viscosity; Handbooks

Library of Congress
Science and Technology Division
Convective Heat Transfer

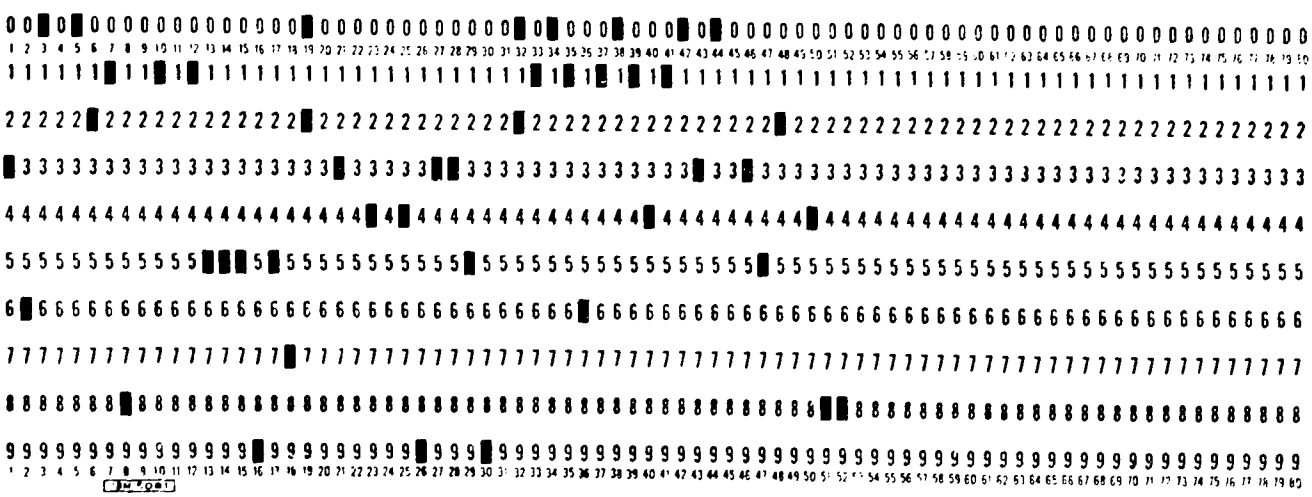
APPENDIX IV

a. Sample IBM cards

1. Open literature; personal author

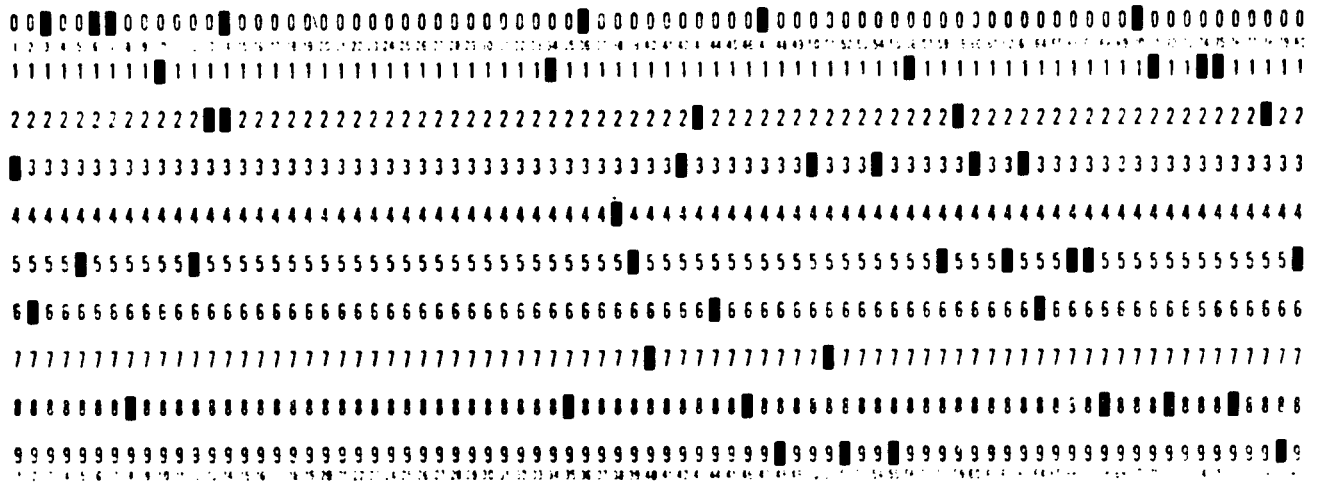


2. Four-digit subject codes

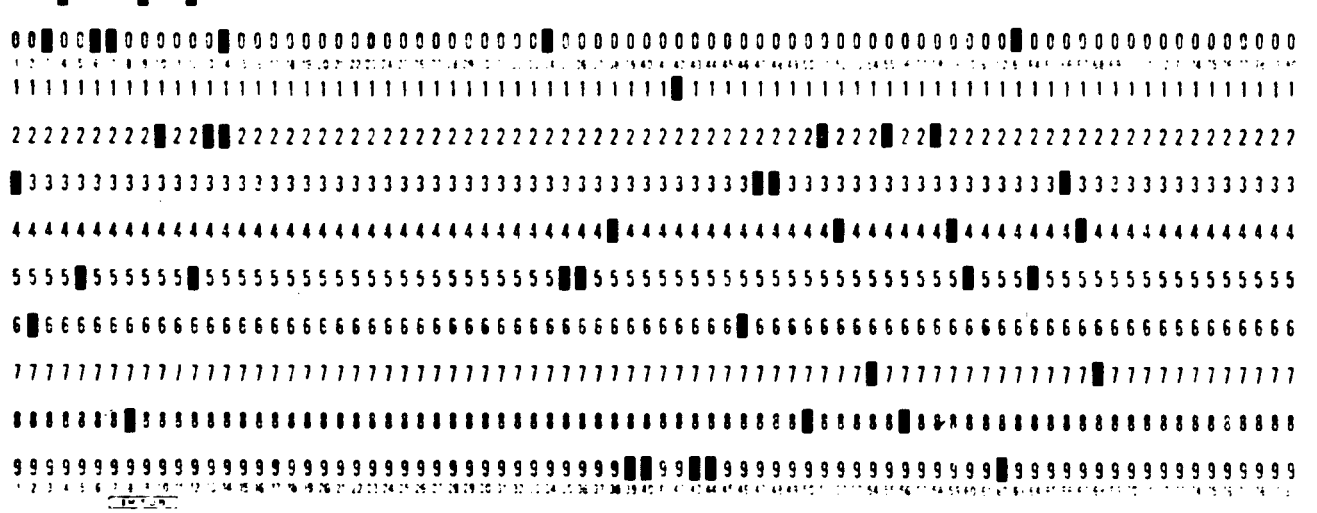


3. Report; corporate author; more than 12 subjects, requiring 2 cards

C60-5008-1 NBS 180 457 326 809 379 391 523 536 558 018 118 295



C60-5008-2 NBS 055 499 199 633 824 728 245 905 347



b. Subject code; numerical listing

001 Ablation
002 Absorber materials
003 Acceleration
004 Acetamide, dimethyl
005 Acetate, butyl
006 Acetate, ethyl
007 Acetate, vinyl
008 Acetone
009 Acetone - water mixtures
010 Acetylene
011 Acoustic effects
012 Acoustic vibration
013 Additives
014 Adiponitrile
015 Aerodynamic heating
016 Aerosols
017 Aerospace vehicles
018 Air
019 Air coils
020 Air coolers
021 Air cooling
022 Aircraft
023 Aircraft, hypersonic
024 Aircraft, supersonic
025 Aircraft (X-15)
026 Aircraft engines
027 Aircraft equipment
028 Aircraft fuel
029 Aircraft materials
030 Airfoils
031 Airframe materials
032 Airframes
033 Air-helium mixtures
034 Alcohols
035 Aliphatic compounds
036 Alloys
037 Altitude
038 Accomodation coefficient
039 Aluminum
040 Aluminum 61S
041 Aluminum 1100
042 Aluminum 3003
043 Aluminum alloys
044 Aluminum bromide
045 Aluminum chloride

046 Aluminum oxide
047 Aluminum-1Mg
048 Aluminum-1.2 Mn
049 Ammonia
050 Analog methods
051 Analysis
052 Annular fins
053 Annular flow
054 Annuli
055 Argon
056 Argon - benzene mixtures
057 Argon - xenon mixtures
058 Armco iron
059 Aspect ratio
060 Austenitic
061 Axial mixing
062 Axially symmetric bodies
063 Bakelite
064 Benzene, 1, 4-diphenoxy
065 Benzene, dichloro
066 Benzene mixtures
067 Benzene - toluene mixtures
068 Benzenes
069 Benzenes, chloro
070 Benzenes, trimethyl
071 Benzoic acid
072 Beryllium
073 Beryllium acetate complex
074 Beryllium copper
075 Beryllium oxide
076 Bibliography
077 Thermometers, bimetallic
078 Binary mixtures
079 Bingham fluid
080 Biphenyl, monoisopropyl
081 Bismuth-lead alloys
082 Ether, bis(p-phenoxyphenyl)
083 Bluff bodies
084 Blunt bodies
085 Bodies of revolution
086 Boilers
087 Boiling
088 Diatomaceous earth, borated
089 Boundary conditions

090 Boundary layer factors
091 Boundary layer flow
092 Boundary layer transition
093 Boundary layers
094 Brass
095 Bromine
096 Bubble formation
097 Bulk boiling
098 Bulk modulus
099 Acetate, amyl
100 Bulk velocity
101 Buoyancy
102 Burnout
103 Butadiene
104 Butane
105 Butane, trichloroheptafluoro
106 Butanol
107 Butene, methyl
108 Butyrate, ethyl
109 Cadminum
110 Calcium aluminates
111 Calcium borate
112 Calibration
113 Calorimeters
114 Carbon
115 Carbon dioxide
116 Air - carbon dioxide mixtures
117 Carbon disulfide
118 Carbon monoxide
119 Alumel
120 Carbon tetrachloride
121 Carbopol
122 Carboxy methyl cellulose
123 Centripetal acceleration
124 Ceramic coatings
125 Ceramic fuels
126 Ceramics
127 Cesium
128 Channels
129 Channels, circular
130 Channels, flat
131 Channels, horizontal
132 Channels, rectangular
133 Channels, triangular

134 Channels, vertical
135 Chlorine
136 Ethanol, 2-chloro - ether, diisopropyl mixtures
137 Chromium
138 Chromium-plated
139 Coatings
140 Compatibility
141 Compressibility
142 Compressible flow
143 Compressors
144 Computation
145 Condensation
146 Condensation coefficient
147 Condensers
148 Condensers, tube
149 Condensers, wire
150 Cones
151 Configuration
152 Contamination
153 Contamination effects
154 Convection coefficient
155 Convection velocity
156 Convective heat transfer
157 Coolant pumps
158 Coolants
159 Cooling
160 Cooling coils
161 Cooling equipment
162 Cooling systems
163 Copper
164 Copper tubes
165 Coriolis forces
166 Corn syrup
167 Correlation
168 Corrosion
169 Cost economy
170 Couette flow
171 Counter flow
172 Creep
173 Critical constants
174 Critical point
175 Critical region
176 Critical state
177 Boron oxide

178 Carbon dioxide - nitrogen mixtures
179 Cross flow
180 Cryogenic fluids
181 Cryogenic hydrogen
182 Cryogenic oxygen
183 Cyclohexane - heptane mixtures
184 Cyclohexanes
185 Cylinders
186 Cylinders, circular
187 Cylinders, concentric
188 Cylinders, elliptical
189 Cylinders, horizontal
190 Cylinders, inclined
191 Cylinders, porous
192 Cylinders, rotating
193 Cylinders, transverse
194 Cylinders, vertical
195 Cylinders, yawed
196 Shells, cylindrical
197 Data
198 Decay heat
199 Density
200 Design
201 Deuterium chloride
202 Deuterium oxide
203 Development
204 Diborane
205 Chloroform
206 Glycol, diethylene
207 Diffusion
208 Diffusion regions
209 Diffusivity
210 Digital methods
211 Amine, dimethyl - ether mixtures
212 Glycol, dimethyltetraethylene
213 Shock waves
214 Diphenyl
215 Diphenyl - diphenyl oxide mixtures
216 Disks
217 Dissociating gas
218 Dissociation-association
219 Dodecanethiol
220 Dodecene
221 Drops

222 Dropwise condensation
223 Ducts
224 Ducts, circular
225 Ducts, cylindrical
226 Ducts, flat
227 Ducts, horizontal
228 Ducts, polygonal
229 Ducts, rectangular
230 Ducts, triangular
231 Ducts, vertical
232 Dural
233 Edges
234 Effectiveness
235 Eicosane
236 Electric fields
237 Electric forces
238 Electrical equipment
239 Electrolytes
240 Electron tubes
241 Electronic equipment
242 Emissivity
243 Enclosures
244 Energy
245 Enthalpy
246 Environment
247 Temperature, environmental
248 Errors
249 Ethane
250 Ethane, trifluoro
251 Ethanol
252 Ether, ethyl
253 Chloroform - ether mixtures
254 Amine, ethyl
255 Ethylene
256 Ethylene, trichloro
257 Ethylene dichloride - toluene mixtures
258 Glycol, ethylene
259 Air - ethylene flames
260 Argon - ethylene mixtures
261 Ethyne
262 Eutectic mixtures
263 Evaporation
264 Evaporation coefficient
265 Evaporators

266 Experimental
267 Film boiling
268 Film condensation
269 Film cooling
270 Film heating
271 Finned tubes
272 Fins
273 Fins, sandwich structure
274 Fins, transverse
275 Flames
276 Flight simulation
277 Flinak (Salt "A")
278 Flow, one-dimensional
279 Flow, three-dimensional
280 Flow, two-dimensional
281 Flow, two-phase
282 Flow control
283 Flow friction
284 Flow measurement
285 Flow pulsations
286 Flow rate
287 Flowmeters
288 Fluid acceleration
289 Fluid flow
290 Fluid friction
291 Fluidized beds
292 Fluids
293 Fluorides
294 Fluorinated hydrocarbons
295 Fluorine
296 Fluoro compounds
297 Fluoroalkanes
298 Forced convection
299 Formamide, dimethyl
300 Formulas
301 Free convection
302 Free molecule flow
303 Freezing
304 Freon
305 Freon 11
306 Freon 12
307 Freon 13
308 Freon 22
309 Freon 113

310 Freon 114
311 Freon 115
312 Friction
313 Friction coefficient
314 Friction factors
315 Fuel elements
316 Fuels
317 Fusion
318 Gallium
319 Gas films
320 Gas flow
321 Gas mixtures
322 Gas thermometers
323 Gas turbine disks
324 Gas turbine materials
325 Gas turbines
326 Gases
327 Chromel
328 Heat exchangers, gas-liquid
329 Gas-liquid mixtures
330 Gas-vapor mixtures
331 Generators
332 Geometric factors
333 Geometry
334 Germanium-silicon alloys
335 Glass
336 Glycerine
337 Glycerol
338 Gold
339 Graetz equation
340 Graetz number
341 Granular solids
342 Graphite
343 Graphite, ATJ
344 Grashof number
345 Gravity
346 Chromium chloride
347 Handbooks
348 Hartmann number
349 Hastelloy X
350 Haynes alloy 25(L605)
351 Hazards
352 Heat capacity
353 Heat exchanger materials

354 Heat exchangers
355 Heat exchangers, air-cooled
356 Heat exchangers, baffled
357 Heat exchangers, counter-flow
358 Heat exchangers, cross-flow
359 Heat exchangers, gas-gas
360 Heat exchangers, parallel-flow
361 Heat exchangers, periodic-flow
362 Heat exchangers, plastic
363 Heat exchangers, ram-air
364 Heat exchangers, shell
365 Heat exchangers, tubular
366 Heat flowmeters
367 Heat flux
368 Heat flux distribution
369 Heat flux probes
370 Heat sink capacity
371 Heat transfer
372 Heat transfer coefficient
373 Heat transfer media
374 Heat transfer models
375 Heaters
376 Heating
377 Heating systems
378 Helical flow
379 Helium
380 Argon - helium mixtures
381 Argon - helium - xenon mixtures
382 Helium - xenon mixtures
383 Hemispheres
384 Heptane
385 Hexadiene
386 Hexane
387 High altitude
388 Hydraulic fluids
389 Hydraulic systems
390 Hydrocarbon flames
391 Hydrogen
392 Hydrogen chloride
393 Hydrogen sulfide
394 Air - hydrogen mixtures
395 Hydrogen - oxygen flames
396 Hydrogen - oxygen mixtures

397 Hypersonic flow
398 Hypervelocity vehicles
399 Ice
400 Ignition
401 Incompressible flow
402 Inconel
403 Inconel X
404 Indicators, chemical
405 Indopol polybutene H300
406 Inert gases
407 Injection cooling
408 Inorganic compounds
409 Instrumentation
410 Intercoolers
411 Interferometric analysis
412 Iodine
413 Ionization
414 Ionized gases
415 Iron
416 Isooctane
417 Jet engines
418 Jets
419 Joule heating
420 Kerosene
421 Kinematic viscosity
422 Knudsen number
423 Krypton
424 Laminar boundary layer
425 Laminar flow
426 Lead
427 Leakage
428 Length-radius ratio
429 Chromium fluoride
430 Heat exchangers, horizontal
431 Helium - nitrogen mixtures
432 Bismuth
433 Heptane, perfluoro
434 Hydrocarbons
435 Liquid films
436 Hydrogen peroxide
437 Deuterium - hydrogen mixtures
438 Hexane - hydrogen mixtures
439 Indium
440 Iridium

441 Liquid metals
442 Heptane, perfluoro - isooctane mixtures
443 Lead - nickel alloys
444 Lithium hydride
445 Nitrogen tetroxide
446 Methane, monochlorodifluoro
447 Methyl iodide
448 Methylene dibromide
449 Nickel tellurides
450 Nickel - titanium carbide
451 Liquid salts
452 Nuclear power systems
453 Pentane, 2, 2, 4 trimethyl
454 Plastisols
455 Glycol, polyalkylene
456 Heat exchangers, liquid-liquid
457 Liquids
458 Lithium
459 Lithium bromide
460 Local boiling
461 Loops
462 Loops, closed
463 Loops, coolant
464 Loops, forced flow
465 Loops, fuel
466 Loops, heat transfer
467 Loops, test
468 Lubricants
469 Lubrication systems
470 Mach number
471 Radon
472 Magnesium
473 Magnesium aluminates
474 Magnesium oxide
475 Magnetic equipment
476 Magnetic fields
477 Magnetic forces
478 Magnetohydrodynamic effects
479 Magnetohydrodynamics
480 Manometers
481 Mass addition
482 Mass transfer
483 Mass transfer effects
484 Mass transfer rates
485 Mathematical analysis

486 Mathematics
487 Matrices
488 Measurement
489 Mechanical efficiency
490 Mechanisms
491 Melting
492 Mercaptans
493 Mercury
494 Metal coatings
495 Metals
496 Meteors
497 Meters
498 Methacrylate, methyl
499 Methane
500 Methane, dichlorodifluoro
501 Methane, trichloromonofluoro
502 Methane, trifluoro
503 Carbon dioxide - methane mixtures
504 Methane - toluene mixtures
505 Methanol
506 Argon - methanol mixtures
507 Dioxane - methanol mixtures
508 Hexane - methanol mixtures
509 Methyl carboxy cellulose
510 Methyl chloride
511 Missiles
512 Missiles (Viking)
513 Mixing headers
514 Mixing length
515 Molasses
516 Molybdenum
517 Molybdenum - 0.5 Ti
518 Molybdenum disulfide
519 Momentum transfer
520 Motion
521 Naphthalenes
522 Navier-Stokes equations
523 Neon
524 Argon - neon mixtures
525 Nichrome
526 Nickel
527 Nickel alloys
528 Nickel-plated
529 Nickel - 20Cr
530 Nickel - Cr(EI - 765)

531 Nickel - titanium alloys
532 Niobium
533 Nitric acid
534 Nitric acid - nitrogen dioxide mixtures
535 Nitric acid - water mixtures
536 Nitrogen
537 Air - nitrogen mixtures
538 Hydrogen - nitrogen mixtures
539 Nonane
540 Nose cones
541 Nozzles
542 Nuclear boilers
543 Nuclear rockets
544 Nucleate boiling
545 Numerical calculations
546 Nusselt number
547 Octane
548 Oil coolers
549 Oils
550 Oleic acid
551 Oil - oleic acid mixtures
552 Organic coolants
553 Organic fluids
554 Organic liquids
555 Orientation
556 Orifices
557 Oscillations
558 Oxygen
559 Nitrogen - oxygen mixtures
560 Refractories
561 Paraffins
562 Parallel flow
563 Enclosures, partial
564 Peclet number
565 Sapphire
566 Pentadiene
567 Pentane
568 Cyclobutane, perfluoro
569 Performance
570 Phase changes
571 Phenyl ether
572 Phosphorus
573 Photographic analysis
574 Phthalate, dibutyl

575 Pipes
576 Pipes, circular
577 Pipes, cylindrical
578 Pipes, horizontal
579 Pipes, inclined
580 Pipes, porous wall
581 Pipes, vertical
582 Planes
583 Planetary atmospheres
584 Plasmas
585 Plastics
586 Plate-fin surfaces
587 Plates
588 Plates, circular
589 Plates, flat
590 Plates, horizontal
591 Plates, parallel
592 Plates, porous
593 Plates, splitter
594 Plates, vertical
595 Platinum
596 Pneumatic systems
597 Poiseuille flow
598 Polyesters
599 Polymers
600 Polymethylmethacrylate
601 Polyphenyls
602 Polystyrene
603 Polytetrafluorethylene
604 Polyvinyl alcohol
605 Pool boiling
606 Porous media
607 Potassium
608 Potassium chloride
609 Potential flow
610 Powders
611 Power plants
612 Prandtl number
613 Prandtl number (0 - 0.1)
614 Prandtl number (0.1 - 1.0)
615 Prandtl number (1.0 - 10.0)
616 Prandtl number (> 10.0)
617 Pressure
618 Vinyl chloride
619 Pressure control

620 Pressure distribution
621 Pressure drop
622 Pressure gages
623 Pressure probes
624 Pressure transducers
625 Prisms
626 Propane
627 Propanol
628 Propene, methyl
629 Propene
630 Glycol, propylene
631 Propyne
632 Psychrometric charts
633 PVT data
634 PVT relations
635 Pyrolysis
636 Pyrometers
637 Quartz
638 Radiation effects
639 Radomes
640 Ranque-Hilsch effect
641 Ranque-Hilsch tubes
642 Rarefied flow
643 Rayleigh number
644 Reactor materials
645 Reactors
646 Reactors, agitated-tank
647 Reactors, automatic-boiling-column
648 Reactors, boiling-water
649 Reactors, breeding
650 Reactors, converter
651 Reactors, fluid-fuel
652 Reactors, gas-cooled
653 Reactors, graphite-moderated
654 Reactors, heterogeneous
655 Reactors, homogeneous
656 Reactors, liquid-metal-cooled
657 Reactors, material-testing
658 Reactors, multipass
659 Reactors, organic-cooled
660 Reactors, organic-moderated
661 Reactors, power
662 Reactors, pressurized-water
663 Reactors, tubular-flow
664 Reactors, water-cooled

665 Recorders
666 Recovery factor
667 Reduced state
668 Reentry conditions
669 Reentry vehicles
670 Refrigerants
671 Refrigeration equipment
672 Regenerators
673 Reliability
674 Research
675 Research facilities
676 Reverse flow
677 Review
678 Reynolds number
679 Reynolds number (0-20)
680 Reynolds number (20 - 2000)
681 Reynolds number (2000 - 200,000)
682 Reynolds number (> 200,000)
683 Rhenium
684 Rocket fuels
685 Rocket motors
686 Rod bundles
687 Rods
688 Rotameters
689 Rotating bodies
690 Rotating ducts
691 Rotating surfaces
692 Rotation
693 Rubidium
694 Saturated vapors
695 Scaling
696 Schmidt number
697 Schwarz-Christoffel transformations
698 Sensitivity
699 Separation flow
700 Serpentine
701 Shear stresses
702 Shielding
703 Shielding materials
704 Silicon carbide
705 Silicon nitride
706 Silicone oil
707 Silicones
708 Silver
709 Simulation

710 Sinusoidal flow
711 Skin friction
712 Skin temperature
713 Slip flow
714 Slots
715 Slug flow
716 Smokes
717 Sodium
718 Sodium hydroxide
719 Potassium - sodium alloys
720 Lithium fluoride - potassium fluoride - sodium fluoride mixtures
721 Sodium fluoride - uranium fluoride - zirconium fluoride mixtures
722 Solid propellants
723 Solidification
724 Solids
725 Sound
726 Spacecraft
727 Spacecraft materials
728 Specific heat
729 Specific volume
730 Specifications
731 Spent fuel
732 Spheres
733 Spikes
734 Stability
735 Stagnation flow
736 Stagnation point
737 Stagnation pressure
738 Stagnation temperature
739 Stainless steel
740 Stainless steel 17-7PH
741 Stainless steel 304
742 Stainless steel 310
743 Stainless steel 321
744 Stainless steel 347
745 Standardization
746 Standards
747 Stanton number
748 Steam
749 Steam generators
750 Steam-water flow
751 Stearic acid
752 Steel

753 Steel 12Cr
754 Steel 1018
755 Steel 1045
756 Steel 3140
757 Steel EI-612
758 Steel M1
759 Steel M2
760 Steel M10
761 Steel Ti
762 Steam - water mixtures
763 Steel, sintered
764 Stiffeners
765 Stroboscopic analysis
766 Subcooling
767 Sublimation
768 Subliming material
769 Submarines
770 Subsonic flow
771 Succinic acid
772 Sulfur
773 Supercooling
774 Supercritical conditions
775 Supercritical fluids
776 Supercritical water
777 Organic compounds
778 Superheated liquids
779 Superheated vapors
780 Superheating
781 Supersaturation
782 Supersonic flow
783 Surface boiling
784 Surface cavities
785 Missiles (Jupiter)
786 Surface tension
787 Surfaces
788 Survey
789 Sweat cooling
790 Tables
791 Tantalum
792 Taylor vortices
793 Teflon
794 Temperature
795 Temperature 000
796 Temperature 010
797 Temperature 030

798 Temperature 050
799 Temperature 070
800 Temperature 090
801 Temperature 110
802 Temperature 130
803 Temperature 150
804 Temperature 170
805 Temperature 190
806 Temperature, adiabatic wall
807 Temperature, bulk
808 Temperature, critical
809 Temperature, cryogenic
810 Temperature, mean
811 Temperature, surface
812 Temperature, wall
813 Temperature control
814 Temperature distribution
815 Terphenyls
816 Test apparatus
817 Test equipment
818 Test facilities
819 Test methods
820 Test results
821 Ethylene, tetrafluoro
822 Tetralin
823 Theory
824 Thermal conductivity
825 Thermal diffusion
826 Thermal diffusivity
827 Thermal efficiency
828 Thermal entrance region
829 Thermal stresses
830 Thermal syphon
831 Thermocouples
832 Thermodynamics
833 Thermoelectric cooling
834 Thermometers
835 Thermopiles
836 Thermosyphon tubes
837 Thickness
838 Thorium
839 Tin
840 Titanium
841 Titanium 55
842 Titanium 75A

843 Titanium 130A
844 Titanium 150A
845 Titanium Tl
846 Titanium alloys
847 Titanium carbide
848 Titanium tetrachloride
849 Titanium-Mo-Cr
850 Toluene
851 Towers, cross - flow
852 Toxicity
853 Tracer studies
854 Transient free convection
855 Transient heat flux
856 Transient heat transfer
857 Transient phenomena
858 Transient temperature
859 Transition boiling
860 Transition flow
861 Transonic flow
862 Asbestos
863 Fiberglas
864 Tube banks
865 Tube orientation
866 Tubes
867 Tubes, baffled
868 Tubes, capillary
869 Tubes, circular
870 Tubes, concentric
871 Tubes, cylindrical
872 Tubes, elliptical
873 Tubes, flat
874 Tubes, fluted
875 Tubes, horizontal
876 Tubes, porous
877 Tubes, rectangular
878 Tubes, round
879 Tubes, smooth
880 Tubes, vertical
881 Tubes, vortex
882 Tungsten
883 Turbine blades
884 Turbine disks
885 Turbulence
886 Turbulent boundary layer
887 Turbulent flow

888 Turpentine
889 Spectroscopic analysis
890 Ultrasonics
891 Uranium alloys
892 Uranium - molybdenum alloys
893 Bismuth - uranium dioxide slurry
894 Uranium oxide
895 Vacuum gages
896 Vapor pressure
897 Vaporization
898 Vaporizing bodies
899 Vapors
900 Velocity
901 Velocity distribution
902 Velocity profile
903 Vibration
904 Viscosimeters
905 Viscosity
906 Viscosity coefficient
907 Viscous fluids
908 Visualization
909 Vitreous silica
910 Volume
911 Volume boiling
912 Vortex flow
913 Vortices
914 VOT (Dowtherm)
915 Walls
916 Waste heat utilization
917 Water
918 Water tunnels
919 Water vapor
920 Air - water mixtures
921 Methyl ethyl ketone - water mixtures
922 Wave motion
923 Waxes
924 Wedges
925 Weight
926 Wetting agents
927 Wind tunnels
928 Wings
929 Wires
930 Wood's metal
931 Working fluids
932 Xenon

933 Xylene
934 Zero gravity conditions
935 Zinc
936 Zirconium oxide
937 Zirconium
938 Shells
939 Shock tubes
940 Films
941 Solubility
942 Sulfur dioxide
943 Benzene - carbon tetrachloride mixtures
944 Ozone
945 Potassium - sodium - uranium dioxide slurry
946 Distillation
947 Absorption
948 Particles
949 Holmium
950 Calcium
951 Anthraquinones
952 Convection
953 Plates, sandwich
954 Terbium
955 Tubes, parallel
956 Centrifugal acceleration
957 Silicon dioxide
958 Ethylene - nitrogen mixtures
959 Liquid - vapor mixtures
960 Nitrous oxide
961 Neptunium
962 Valves
963 Viscous flow
964 Froude number
965 Composite bodies
966 Thorium oxide
967 Liquid state
968 Missiles (Polaris)
969 Ferrous chloride
970 Laminates
971 Electromagnetic waves
972 Glycerine - water mixtures
973 Milk
974 Aluminum fluoride
975 Boron halides
976 Lithium halides
977 Sodium chloride

978 Air - glycerine mixtures
979 Alkyl halides
980 Amine, diethyl - water mixtures
981 Thiol, trifluoromethane
982 Neon - nitrogen mixtures
983 Krypton - nitrogen mixtures
984 Nitrogen - xenon mixtures
985 Acetic acid - water mixtures
986 Capric acid, perfluoro
987 Molecular beams
988 Nitric oxide
989 Silicon halides
990 Zinc halides
991 Sulfur halides
992 Argon - hydrogen mixtures
993 Argon - nitrogen mixtures
994 Argon - oxygen mixtures
995 Helium - oxygen mixtures
996 Krypton - oxygen mixtures
997 Oxygen - xenon mixtures
998 Iron sulfate
999 Deuterium

1000 (Not used)
1001 Acetamide, dimethyl - water mixtures
1002 Air - benzene mixtures
1003 Bismuth telluride
1004 Bismuth - thorium slurry
1005 Boron
1006 Boron hydrides
1007 Carbon tetrachloride - methylene chloride mixtures
1008 Carbon tetrachloride - water mixtures
1009 Chlorine monofluoride
1010 Glycerol - water mixtures
1011 Gold alloys
1012 Hydrogen - water vapor mixtures
1013 Krypton - xenon mixtures
1014 Lanthanum
1015 Lead - uranium slurry
1016 Lutetium
1017 Methane, bromodichlorofluoro
1018 Methane, dibromochlorofluoro
1019 Neon - xenon mixtures
1020 Nitrogen - oil mixtures
1021 Octadecane
1022 Oil - water mixtures
1023 Palladium
1024 Pyrrolidine
1025 Samarium
1026 Sulfuryl halides
1027 Uranium
1028 Uranium tetrafluoride
1029 Undecene
1030 Yttrium
1031 Air - methanol mixtures
1032 Air - toluene mixtures

c. Subject code; alphabetical listing

001 Ablation
002 Absorber materials
947 Absorption
003 Acceleration
038 Accommodation coefficient
004 Acetamide, dimethyl
1001 Acetamide, dimethyl - water mixtures
099 Acetate, amyl
005 Acetate, butyl
006 Acetate, ethyl
007 Acetate, vinyl
985 Acetic acid - water mixtures
008 Acetone
009 Acetone - water mixtures
010 Acetylene
011 Acoustic effects
012 Acoustic vibration
013 Additives
014 Adiponitrile
015 Aerodynamic heating
016 Aerosols
017 Aerospace vehicles
018 Air
019 Air coils
020 Air coolers
021 Air cooling
1002 Air - benzene mixtures
116 Air - carbon dioxide
022 Aircraft
023 Aircraft, hypersonic
024 Aircraft, supersonic
025 Aircraft (X-15)
026 Aircraft engines
027 Aircraft equipment
028 Aircraft fuel
029 Aircraft material
259 Air - ethylene flames
030 Airfoils
031 Airframe materials
032 Airframes
978 Air - glycerine mixtures
033 Air - helium mixtures
394 Air - hydrogen mixtures
1031 Air - methanol mixtures
537 Air - nitrogen mixtures

1032 Air - toluene mixtures
920 Air - water mixtures
034 Alcohols
035 Aliphatic compounds
979 Alkyl halides
036 Alloys
037 Altitude
119 Alumel
039 Aluminum
040 Aluminum 61S
041 Aluminum 1100
042 Aluminum 3003
043 Aluminum alloys
044 Aluminum bromide
045 Aluminum chloride
974 Aluminum fluoride
046 Aluminum oxide
047 Aluminum-1Mg
048 Aluminum-1Mn
980 Amine, diethyl - water mixtures
211 Amine, dimethyl - ether mixtures
254 Amine, ethyl
049 Ammonia
050 Analog methods
051 Analysis
052 Annular fins
053 Annular flow
054 Annuli
951 Anthraquinones
055 Argon
056 Argon - benzene mixtures
260 Argon - ethylene mixtures
380 Argon - helium mixtures
381 Argon - helium - xenon mixtures
992 Argon - hydrogen mixtures
506 Argon - methanol mixtures
524 Argon - neon mixtures
993 Argon - nitrogen mixtures
994 Argon - oxygen mixtures
057 Argon - xenon mixtures
058 Armco iron
862 Asbestos
059 Aspect ratio
060 Austenitic
061 Axial mixing
062 Axially symmetric bodies

063 Bakelite
064 Benzene, 1, 4-diphenoxy
065 Benzene, dichloro
066 Benzene mixtures
943 Benzene - carbon tetrachloride mixtures
067 Benzene - toluene mixtures
068 Benzenes
069 Benzenes, chloro
070 Benzenes, trimethyl
071 Benzoic acid
072 Beryllium
073 Beryllium acetate complex
074 Beryllium copper
075 Beryllium oxide
076 Bibliography
078 Binary mixtures
079 Bingham fluid
080 Biphenyl, monoisopropyl
432 Bismuth
1003 Bismuth telluride
081 Bismuth - lead alloys
1004 Bismuth - thorium slurry
893 Bismuth - uranium dioxide slurry
083 Bluff bodies
084 Blunt bodies
085 Bodies of revolution
086 Boilers
087 Boiling
1005 Boron
975 Boron halides
1006 Boron hydrides
177 Boron oxide
089 Boundary conditions
090 Boundary layer factors
091 Boundary layer flow
092 Boundary layer transition
093 Boundary layers
094 Brass
095 Bromine
096 Bubble formation
097 Bulk boiling
098 Bulk modulus
100 Bulk velocity
101 Buoyancy
102 Burnout

103 Butadiene
104 Butane
105 Butane, trichloroheptafluoro
106 Butanol
107 Butene, methyl
108 Butyrate, ethyl

109 Cadmium
950 Calcium
110 Calcium aluminates
111 Calcium borate
112 Calibration
113 Calorimeters
986 Capric acid, perfluoro
114 Carbon
115 Carbon dioxide
503 Carbon dioxide - methane mixtures
178 Carbon dioxide - nitrogen mixtures
117 Carbon disulfide
118 Carbon monoxide
120 Carbon tetrachloride
1007 Carbon tetrachloride - methylene chloride mixtures
1008 Carbon tetrachloride - water mixtures
121 Carbopol
122 Carboxy methyl cellulose
956 Centrifugal acceleration
123 Centripetal acceleration
124 Ceramic coatings
125 Ceramic fuels
126 Ceramics
127 Cesium
128 Channels
129 Channels, circular
130 Channels, flat
131 Channels, horizontal
132 Channels, rectangular
133 Channels, triangular
134 Channels, vertical
135 Chlorine
1009 Chlorine monofluoride
205 Chloroform
253 Chloroform - ether mixtures
327 Chromel
137 Chromium
346 Chromium chloride

311 Freon 115
312 Friction
313 Friction coefficient
314 Friction factors
964 Froude number
315 Fuel elements
316 Fuels
317 Fusion

318 Gallium
319 Gas films
320 Gas flow
321 Gas mixtures
322 Gas thermometers
323 Gas turbine disks
324 Gas turbine materials
325 Gas turbines
326 Gases
329 Gas-liquid mixtures
330 Gas-vapor mixtures
331 Generators
332 Geometric factors
333 Geometry
334 Germanium-silicon alloys
335 Glass
336 Glycerine
972 Glycerine - water mixtures
337 Glycerol
1010 Glycerol - water mixtures
206 Glycol, diethylene
212 Glycol, dimethyltetraethylene
258 Glycol, ethylene
455 Glycol, polyalkylene
630 Glycol, propylene
338 Gold
1011 Gold alloys
339 Graetz equation
340 Graetz number
341 Granular solids
342 Graphite
343 Graphite, ATJ
344 Grashof number
345 Gravity

554 Organic liquids
555 Orientation
556 Orifices
557 Oscillations
558 Oxygen
997 Oxygen - xenon mixtures
944 Ozone

1023 Palladium
561 Paraffins
562 Parallel flow
948 Particles
564 Peclet number
566 Pentadiene
567 Pentane
453 Pentane, 2, 2, 4 trimethyl
569 Performance
570 Phase changes
571 Phenyl ether
572 Phosphorus
573 Photographic analysis
574 Phthalate, dibutyl
575 Pipes
576 Pipes, circular
577 Pipes, cylindrical
578 Pipes, horizontal
579 Pipes, inclined
580 Pipes, porous wall
581 Pipes, vertical
582 Planes
583 Planetary atmospheres
584 Plasmas
585 Plastics
454 Plastisols
586 Plate-fin surfaces
587 Plates
588 Plates, circular
589 Plates, flat
590 Plates, horizontal
591 Plates, parallel
592 Plates, porous
953 Plates, sandwich
593 Plates, splitter
594 Plates, vertical
595 Platinum

638 Radiation effects
639 Radomes
471 Radon
640 Ranque-Hilsch effect
641 Ranque-Hilsch tubes
642 Rarefied flow
643 Rayleigh number
644 Reactor materials
645 Reactors
646 Reactors, agitated-tank
647 Reactors, automatic-boiling-column
648 Reactors, boiling-water
649 Reactors, breeding
650 Reactors, converter
651 Reactors, fluid-fuel
652 Reactors, gas-cooled
653 Reactors, graphite-moderated
654 Reactors, heterogeneous
655 Reactors, homogeneous
656 Reactors, liquid-metal-cooled
657 Reactors, material-testing
658 Reactors, multipass
659 Reactors, organic-cooled
660 Reactors, organic-moderated
661 Reactors, power
662 Reactors, pressurized-water
663 Reactors, tubular-flow
664 Reactors, water-cooled
665 Recorders
666 Recovery factor
667 Reduced state
668 Reentry conditions
669 Reentry vehicles
560 Refractories
670 Refrigerants
671 Refrigeration equipment
672 Regenerators
673 Reliability
674 Research
675 Research facilities
676 Reverse flow
677 Review
678 Reynolds number
679 Reynolds number (0 - 20)
680 Reynolds number (20 - 2000)

718 Sodium hydroxide
721 Sodium fluoride - uranium fluoride - zirconium fluoride mixtures
722 Solid propellants
723 Solidification
724 Solids
941 Solubility
725 Sound
726 Spacecraft
727 Spacecraft materials
728 Specific heat
729 Specific volume
730 Specifications
889 Spectroscopic analysis
731 Spent fuel
732 Spheres
733 Spikes
734 Stability
735 Stagnation flow
736 Stagnation point
737 Stagnation pressure
738 Stagnation temperature
739 Stainless steel
740 Stainless steel 17-7PH
741 Stainless steel 304
742 Stainless steel 310
743 Stainless steel 321
744 Stainless steel 347
745 Standardization
746 Standards
747 Stanton number
748 Steam
749 Steam generators
750 Steam - water flow
762 Steam - water mixtures
751 Stearic acid
752 Steel
753 Steel 12Cr
754 Steel 1018
755 Steel 1045
756 Steel 3140
757 Steel EI-612
758 Steel M1
759 Steel M2
760 Steel M10
761 Steel Ti

763 Steel, sintered
764 Stiffeners
765 Stroboscopic analysis
766 Subcooling
767 Sublimation
768 Subliming material
769 Submarines
770 Subsonic flow
771 Succinic acid
772 Sulfur
942 Sulfur dioxide
991 Sulfur halides
1026 Sulfuryl halides
773 Supercooling
774 Supercritical conditions
775 Supercritical fluids
776 Supercritical water
778 Superheated liquids
779 Superheated vapors
780 Superheating
781 Supersaturation
782 Supersonic flow
783 Surface boiling
784 Surface cavities
786 Surface tension
787 Surfaces
788 Survey
789 Sweat cooling

790 Tables
791 Tantalum
792 Taylor vortices
793 Teflon
794 Temperature
795 Temperature 000
796 Temperature 010
797 Temperature 030
798 Temperature 050
799 Temperature 070
800 Temperature 090
801 Temperature 110
802 Temperature 130
803 Temperature 150
804 Temperature 170
805 Temperature 190

806 Temperature, adiabatic wall
807 Temperature, bulk
808 Temperature, critical
809 Temperature, cryogenic
247 Temperature, environmental
810 Temperature, mean
811 Temperature, surface
812 Temperature, wall
813 Temperature control
814 Temperature distribution
954 Terbium
815 Terphenyls
816 Test apparatus
817 Test equipment
818 Test facilities
819 Test methods
820 Test results
822 Tetralin
823 Theory
824 Thermal conductivity
825 Thermal diffusion
826 Thermal diffusivity
827 Thermal efficiency
828 Thermal entrance region
829 Thermal stresses
830 Thermal syphon
831 Thermocouples
832 Thermodynamics
833 Thermoelectric cooling
834 Thermometers
077 Thermometers, bimetallic
835 Thermopiles
836 Thermosyphon tubes
837 Thickness
981 Thiol, trifluoromethane
838 Thorium
966 Thorium oxide
839 Tin
840 Titanium
841 Titanium 55
842 Titanium 75A
843 Titanium 130A
844 Titanium 150A
845 Titanium Tl
846 Titanium alloys

847 Titanium carbide
848 Titanium tetrachloride
849 Titanium-Mo-Cr
850 Toluene
851 Towers, cross-flow
852 Toxicity
853 Tracer studies
854 Transient free convection
855 Transient heat flux
856 Transient heat transfer
857 Transient phenomena
858 Transient temperature
859 Transition boiling
860 Transition flow
861 Transonic flow
864 Tube banks
865 Tube orientation
866 Tubes
867 Tubes, baffled
868 Tubes, capillary
869 Tubes, circular
870 Tubes, concentric
871 Tubes, cylindrical
872 Tubes, elliptical
873 Tubes, flat
874 Tubes, fluted
875 Tubes, horizontal
955 Tubes, parallel
876 Tubes, porous
877 Tubes, rectangular
878 Tubes, round
879 Tubes, smooth
880 Tubes, vertical
881 Tubes, vortex
882 Tungsten
883 Turbine blades
884 Turbine disks
885 Turbulence
886 Turbulent boundary layer
887 Turbulent flow
888 Turpentine

1029 Undecene
890 Ultrasonics
1027 Uranium
891 Uranium alloys
1028 Uranium tetrafluoride
892 Uranium - molybdenum alloys
894 Uranium oxide

895 Vacuum gages
962 Valves
896 Vapor pressure
897 Vaporization
898 Vaporizing bodies
899 Vapors
900 Velocity
901 Velocity distribution
902 Velocity profile
903 Vibration
618 Vinyl chloride
904 Viscosimeters
905 Viscosity
906 Viscosity coefficient
963 Viscous flow
907 Viscous fluids
908 Visualization
909 Vitreous silica
910 Volume
911 Volume boiling
912 Vortex flow
913 Vortices
914 VOT (Dowtherm)

915 Walls
916 Waste heat utilization
917 Water
918 Water tunnels
919 Water vapor
922 Wave motion
923 Waxes
924 Wedges
925 Weight
926 Wetting agents
927 Wind tunnels
928 Wings
929 Wires
930 Wood's metal
931 Working fluids

932	Xenon
933	Xylene
1030	Yttrium
934	Zero gravity conditions
935	Zinc
990	Zinc halides
937	Zirconium
936	Zirconium oxide

d. Codes for Temperature ranges

Code No.	Designation	°K	°C	°F
795	Temp 000	0 to 33	-273 to -240	-459 to -400
796	Temp 010	34 to 200	-239 to -73	-399 to -99
797	Temp 030	201 to 293	-72 to +20	-98 to +68
798	Temp 050	294 to 373	21 to 100	69 to 212
799	Temp 070	374 to 589	101 to 316	213 to 600
800	Temp 090	590 to 811	317 to 538	601 to 1000
801	Temp 110	812 to 1089	539 to 816	1001 to 1500
802	Temp 130	1090 to 1922	817 to 1649	1501 to 3000
803	Temp 150	1923 to 5811	1650 to 5538	3001 to 10,000
804	Temp 170	5812 to 55,811	5539 to 55,538	10,001 to 100,000
805	Temp 190	over 55,811	over 55,538	over 100,000

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